Remarks

General Comments

Although the present amendment is submitted after final rejection, it is believed that entry thereof is appropriate and is respectfully requested. It is asserted by Applicants that the amendment made to claim 1 puts all pending claims in condition for allowance; at the very least, the amendment made puts the claims in better form for appeal.

In the "Response to Arguments" portion of the Official Action, at pages 17 and 18, an interpretation of the term "exfoliation" is put forward that is contrary to the clear and unambiguous way the term is employed in the above-captioned application. As used in the application, as well as in the art to which this application pertains, exfoliation refers to the expansion of intercalated natural graphite particles upon exposure to heat (see, e.g., page 4, lines 24-25 of the application:"... expanded graphite structure (also referred to as exfoliated or intumesced graphite) ..."). With this proper reading of the term, as used by Applicants, it is believed Applicants traverse of the outstanding rejections, both herein and in the prior response, becomes clear and persuasive.

Rejection Under 35 U.S.C. §102(e)

Claims 1-3, 5, 7 and 8 again stand rejected under 35 U.S.C. §102 based upon U.S. Patent No. 6,075,287 to Ingraham *et al.* That rejection is respectfully traversed for the following reasons.

As previously noted, claim 1 is directed to an "isolated thermal interface." The thermal interface is a very thin sheet of material which fits between the electrical device and a heat sink. Such a thermal interface may be used in place of conventional thermal greases or adhesives which are commonly used to connect the electrical device to the heat sink.

Significantly, the invention of the above-captioned application related to use of a flexible graphite sheet as the claimed thermal interface material. In addition, as amended herein, claim 1

now explicitly includes the further limitation (which was implicit in the term flexible graphite sheet) that the sheet is formed from particles of natural graphite (support for this amendment can be found at, *inter alia*, page 8, line 23 of the above-captioned application).

The Ingraham *et al.* reference discloses nothing of relevance other than the conventional use of adhesives or thermal greases as an interface between its electrical device 14 and its heat sinks 12 or 12A. The interfaces of Ingraham *et al.* are the layers 15 and 16.

In the Official Action the analogy is made between Ingraham's heat sinks 12 and 12A and the thermal interface of claim 1, apparently because both are made of graphite. However, the members 12 and 12A of Ingraham *et al.* are not thermal interfaces. They are heat sinks. a heat sink provides a thermal interface

The purpose of the present invention, which provides an isolated thermal interface, is to prevent graphite flakes from the interface to flake off and interfere with the performance of the electronic device which physically engages the interface. That is not an issue with regard to the graphite heat sinks 12 and 12A of Ingraham *et al.*, since they are not engaged with the electronic device 14.

More importantly, the graphite material is Ingraham *et al.* is described as "rigid" and able to "resist deformation" (see, e.g., Ingraham *et al.*, col. 7, line 59), and there is no disclosure whatsoever of the use of a natural graphite material. This is directly contrary to the claimed "flexible" graphite sheet, formed of "natural" graphite. The difference is more than mere semantics. A rigid, non-deformable material would not be advantageous as a thermal interface, since it is the very flexibility and deformability of the claimed material that is needed in these applications. As noted at page 7, lines 17-19, it is critical that the thermal interface achieve a good operative connection with the heat source (*i.e.*, the electronic component). A rigid, non-deformable material cannot adequately conform to the surface of the heat source, sacrificing thermal conduction. The inventive flexible material, however, conforms well to a surface, allowing superior function as an interface material.

refers to naturally occurring mechanism
See Cl. 6, lines 16-23. Graphite is resilient

Thus, Ingraham *et al.* cannot and does not anticipate the invention of claim 1, nor, therefore, of any of claims 2, 3, 5, 7 and 8 depending thereform. In the interest of completeness, however, the further distinctions of the dependent claims will again be reviewed.

With regard to claim 2, the protective coating is required to be a thermoplastic material. The Official Action has referred to the language at column 5 line 31, however it is noted that the language at column 5 line 31 is not describing Ingraham's interface layers 15 or 16 but instead is describing a cylindrical insulator 28 which surrounds an electrical connection 30 extending through the thickness of the heat sink 12A. There is no suggestion in Ingraham *et al.* of the use of a thermoplastic material in place of or surrounding the adhesive or thermal grease layer 16 or 15, respectively. The same is true of the comments regarding claim 3 which requires that the thermoplastic comprise a polyimide.

Claim 5 requires that the protective coating around the thermal interface be "effective to electrically isolate the coated major surface of the sheet of flexible graphite particles." The language referred to in the Action, however, is referring to a coating on the heat sink 12A, not on the interface layer 15. The interface layer 15 is itself of course non electrically conducting and there is no reason to "isolate" Ingraham's interface layers 15 or 16.

Claim 7 further requires a layer of adhesive interposed between the protective coating and the flexible graphite sheet which makes up the thermal interface. This time the Action refers to column 5 lines 30-35 of Ingraham apparently for its mention that the material used for the cylindrical insulator 28 may be in a solid sheet or insert material applied adhesively. That begs the question that Ingraham *et al.* does not show or suggest the use of such a coating or adhesive on a thermal interface between an electrical component and a heat sink.

Finally, with regard to claim 8 which requires that the adhesive be selected from the group consisting of acrylic and latex materials, the Official Action refers to column 5 line 32 of Ingraham

et al. With respect, it is not seen where there is any discussion there of acrylic or latex materials utilized as an adhesive. Furthermore, as noted with regard to claim 7, this entire discussion in Ingraham *et al.* has nothing to do with an isolating coating on a thermal interface. Instead, it deals with an electrical insulator 28 placed about an electrical conductor 30 which connects two electrical devices. Ingraham *et al.* essentially provides coated wires extending through its heat sink 12A to connect electrical devices on opposite sides of the heat sink. This has absolutely nothing to do with the issue of utilizing a flexible graphite sheet as a thermal interface between an electrical device and a heat sink, and the need to coat that flexible graphite sheet in order to prevent graphite flakes from contaminating the electrical device.

Accordingly, it is respectfully submitted that the 35 U.S.C. §102 rejection based upon Ingraham *et al.* is inappropriate and should be withdrawn.

Rejections Under 35 U.S.C. §103(a)

Claims 4 and 6 stand rejected under35 U.S.C. §103 based upon Ingraham *et al.* and claim 9 stands rejected under 35 U.S.C. §103 based upon Ingraham *et al.* in view of Unger.

With regard to claims 4 and 9 which specify maximum thicknesses of the protective coating, the Action has not provided any prior art basis for the rejection but instead relies on mere speculation that it would have been obvious to modify the coating to make it thinner because that would maximize the thermal conductivity.

With respect, the speculation is misplaced. The use of a thin plastic protective covering such as that of claim 4 would not even be attempted by persons of ordinary skill in the art. The handling and bonding of extremely thin (less than 0.025 mm) plastic sheets is very difficult. The ultra-thin plastic also must be applied to maintain the smooth surface of the interface without

wrinkling so as to maintain the best thermal contact. Thus claims which provide for the use of a very thin plastic are not in any way suggested by the Examiner's speculation or the cited references.

With regard to claim 9, that claim is directed to the thickness of the layer of adhesive which is required to be no more than about 0.015 mm in thickness. The Official Action has provided no explanation as to why it would be obvious to have an ultra-thin adhesive layer between the interface and the protective coating.

With regard to claim 6, which requires that the flexible graphite sheet comprising the thermal interface have an edge surface with at least one edge surface being coated with a protective coating sufficient to inhibit flaking of the particles of graphite, there is a discussion of pencil lead. With respect, it appears that there is confusion between the terms "exfoliated graphite" (which applicants used to refer to chemically modified, thermally expanded, compressed natural graphite-based flexible sheet) with the laminar characteristic of all graphite material in general. The graphite used in pencils is typically a combination of graphite with a binder; the use of these materials for writing is due to the laminar characteristics of graphite. Because of the binder, pencil graphites do not flake or generate particles except during the application of pressure and shear forces in writing. The use of graphite for writing would not lead one to expect a need to coat the graphite heat sink of Ingraham, since there are no shear forces involved in the Ingraham structure.

The action further contains a rejection of all claims 1-20 under 35 U.S.C. §103(a) based on the newly cited reference Grapes *et al.* (U.S. 4,867,225) in view of Ingraham *et al.*

Grapes *et al.* is cited for the disclosure of a flexible graphite sheet formed of particles of graphite, and its use as a thermal interface material (col. 5, lines 48-55). However, that is not at all the disclosure of this reference. In fact, what is taught be Grapes *et al.* is a composite material formed of synthetic graphite fibers, not natural graphite particles, embedded in a resin, where the

resin is the continuous phase. This is completely different from a flexible graphite sheet formed from compressed, exfoliated natural graphite particles.

In addition, whatever the disclosure of Grapes *et al.*, the fact remains that Ingraham *et al.* relates to the use of a rigid, non-deformable material for use as a heat sink. Accordingly, there is no motivation to combine the references, and there can be no combination of the two references that would render obvious the claimed invention.

Thus the rejection of claims 1-20 under 35 U.S.C. §103(a) over Grapes *et al.* in view of Ingraham *et al.* cannot stand.

Claims 11 and 13 further stand rejected under 35 U.S.C. §103(a) over Grapes *et al.* in view of Ingraham *et al.* further in view of Cheskis *et al.* (U.S. 5,650,592).

The citation of Cheskis *et al.* is apparently to try to provide some support for rejection of those claims such as claim 11 which require that the coating flow around at least one edge surface. With respect, Cheskis *et al.* shows nothing more than that articles can be completely coated. The article 12 of Cheskis is not a flexible graphite sheet. The article 12 of Cheskis is not a thermal interface. The coating 22 of Cheskis is a thermally conductive coating which is described as a "metallic layer".

The article 12 of Cheskis does not include particles of graphite which can flake, but instead as shown in Fig. 2 of Cheskis its article 12 is made up of spheroids of graphite in a molten metal matrix 20.

Cheskis does not disclose a flexible graphite sheet of any kind, and thus Cheskis does not disclose a flexible graphite sheet having at least one major surface and at least one edge surface. Cheskis simply does not deal with the same problem as the present invention.

Accordingly, this rejection should also be withdrawn.

Conclusion

In summary, it is believed that the arguments and amendments set forth above are sound, and accordingly reconsideration of the application is requested along with an indication of the allowance of all claims 1-20 as amended. If there remains any matter that prevents the allowance of any of claims 1-20, the Examiner is requested to call the undersigned collect at 615.242.2400 to arrange for an interview that may expedite prosecution.

Respectfully submitted,

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I hereby certify that this AMENDMENT is being deposited with the United States Postal Service on the date shown below, as first class mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231.

Phyllis Bishop

Phyllis Bishop

9.30.02

Date